M.E. 2nd Semester (EE) Final Examination, April, 2014

Subject: Dynamics of Regulated Machines

(EE-1010)

Time: 3 hours | Full Marks:70

Answer any **Five** questions

The questions are of equal value

Q. 1(a) What is participation factor in small signal oscillations of a synchronous machine connected to a multi-bus power system network.

(b) What is swing mode? What is its implications? [8+6]

Q. 2(a) What is the significance of the K-constants in Hefron Philips model of small signal perturbation model of a synchronous machine? How do they depend on external network parameters?

(b) What are the assumptions of the small signal model of a synchronous machine connected to an infinite bus? [9+5]

Q.3 Explain analytically the role of exciter in the small signal oscillatory model of a synchronous machine. [14]

Q. 4(a) Describe the Routh-Hurwitz stability criterion in detail to find out the conditions of stability starting from first order to fifth order polynomials.

(b) Write down the equations and investigate the compensation and stability of a cross field machine with the help of Routh- Hurwitz criterion. [7+7]

Q. 5(a) In the structural diagram of a closed loop automatic control system, the basic elements are represented by three series connected aperiodic links. The data of the individual links is as follows:

$T_1 = 0.01$ $K_1 = 40$

$T_2 = 0.34$ $K_2 = 1$

$T_3 = 0.1$ $K_3 = 15$

Check the stability of the system.

A flexible negative feedback network having a transfer function of the type $\tau P/(1+\tau P)$ be connected in two different ways

(i) When the stabilizing feedback network encloses the first two links.

(ii) When the stabilizing feedback network encloses only the first link.

Construct the D-decomposition curve in terms of the parameter τ and check the stability of the system in both the cases with $\tau = 0.5$. [7+7]

Q. 6(a) Explain the working principal in detail and develop the equations of the individual elements to draw the structural diagram of the speed regulating system of a d.c.motor.

Check the stability of the system with its parameters having the following values:

T_1= 0.1 Sec T_2= 0.1 Sec

T_3=0.5 Sec T_4= 0.01 Sec

The overall gain of the system K_{av}= 800

(b) Show with diagram that if a stabilizing device in the form of RC circuit is introduced into the system, the system will remain stable for an infinite increase of its gain with τ =0.01 and $K_3K_4K_5$=100. [8+6]

Q. 7(a) Find the overall transfer function of an armature controlled d.c. motor with field excitation current kept constant.

(b) Explain the working principle of the automatic regulating system for the d.c.generator voltage and draw the network configuration of the voltage regulating system. Assuming T_1= 0.005, T_2= 0.05 and T_3=0.5 Sec, find the largest value of the overall gain at which the system remains stable. [6+8]

Q. 8(a) In the structural diagram of a closed loop automatic control system, the basic elements are represented by four series connected aperiodic links. The data of the individual links is as follows:

T_1=0.01 T_2=0.5

T_3=0.5 T_4=1

K_1=100 K_2=1

τ =0.2

A flexible negative feedback network having a transfer function of the type $\tau P/(1+ \tau P)$ be connected in two different ways

(i) When the stabilizing feedback network encloses the first two links.

(ii) When the stabilizing feedback network encloses only the first link.

Construct the D-decomposition curve in terms of the overall gain factor K.

Compare the D-decomposition curves of the two structures from the aspects of the possibility of obtaining a better quality of the transient response.

(b) State and explain Mikhailov stability criterion to investigate the stability of an automatic regulating system. [7+7]